Hydrogeologic Susceptibility and Vulnerability Assessment for Valley Motors, Wasilla, Alaska

DRINKING WATER PROTECTION PROGRAM REPORT *144*

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By URS

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By URS

Drinking Water Protection Program
Alaska Department of Environmental Conservation

EXECUTIVE SUMMARY

Valley Motors is a Class B (transient/noncommunity) drinking water source consisting of one well. Identified potential and current sources of contaminants for Valley Motors include: residential septic systems, highways and roads, plastic and synthetic fiber manufacturer, and approximately 23.5 acres of residential area. These identified potential and existing sources of contamination are considered sources of bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals. Overall, the Valley Motors public water source received a vulnerability rating of **Low** for bacteria and viruses, **Low** for nitrates and/or nitrites, and **Medium** for volatile organic chemicals.

INTRODUCTION

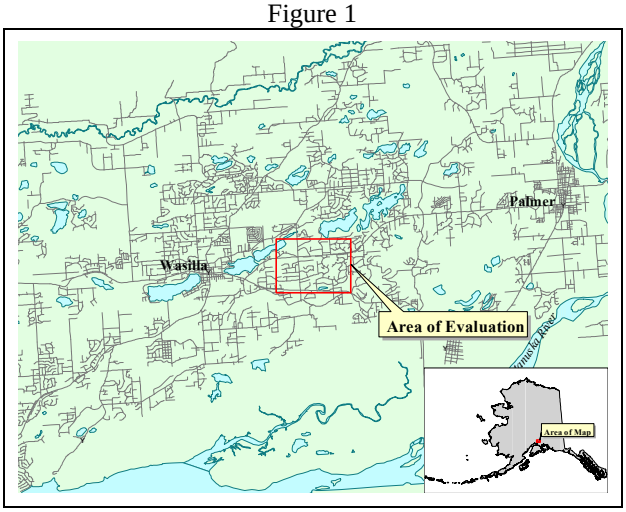
The purpose of this environmental assessment is to provide public water system owners and/or operators, communities, and local governments with information they can use to preserve the quality of Alaska's public drinking water supplies. This assessment was completed for Valley Motors source of public drinking water. This source consists of one well in the Wasilla area (see Figure 1). This assessment, known under the Alaska Drinking Water Protection Program as the *Source Water Assessment*, has combined a review of the natural hydrogeologic sensitivity with potential and existing contaminant risks to arrive at an overall vulnerability of the drinking water source to contamination. This assessment has been completed as a basis for local voluntary protection efforts and to assist agencies in their efforts to reduce risk to this public drinking water supply.

DESCRIPTION OF THE WASILLA-AREA, ALASKA

Location

Wasilla is located near the center of the Matanuska Susitna (Mat-Su) Borough in south central Alaska. The Mat-Su Borough encompasses approximately 23,000 square miles, including the majority of the drainage of the Susitna and Matanuska Rivers. Wasilla is located south of the Talkeetna Mountains, about 12 miles north of Knik Arm on Cook Inlet (*Wickersham Alaska Corporation, 1986*), (*Matanuska-Susitna Borough/Fran Seager, 1991*). Wasilla is 30 air miles north/northeast of Anchorage, adjacent to the Alaska Railroad main line and the George Parks Highway (*ADNR, 1981*).

Figure 1



Glacial forces during the end of the last ice age shaped the Wasilla area. Several glacial advances and retreats left a complex system of hills, ridges, lakes, and lowlands that define the topography of today. Landforms in and around Wasilla consist of undulating ridges of glacial till and flat benches of sand and gravel out wash (*Matanuska-Susitna Borough, 1985*).

Climate

The climate in Wasilla is transitional between the extremes of Interior Alaska and the wet conditions found along the coastal areas.

Wasilla is less than 15 miles from Knik Arm and about 75 miles from Prince William Sound. Summer temperatures are more moderate than those in the Interior due to the proximity to the coast. The Chugach and Talkeetna Mountains and the Alaska Range also protect Wasilla from the frigid cold of the Interior Alaska winter and act to break up strong storm fronts (*Brabets, 1997*), (*Western Regional Climate Center, 2000*).

Wasilla averages about 18 inches of precipitation per year, including about 59 inches of snowfall. Winter thaws can decrease snow cover to a few inches. Mean monthly high temperatures in Wasilla range from about 22 degrees in December and January to 69 degrees in July. The frost-free period in spring and summer averages 115 days, with the first frost usually arriving by September 1.

The record low for Wasilla was -50 degrees in January 1947. The highest recorded temperature was 90 degrees in 1969 (*Wickersham Alaska Corporation, 1986*).

Topography and Drainage

The Wasilla area topography varies from about 300 feet to 500 feet above sea level. The surrounding terrain gradually rises from south to north. The Wasilla area has hundreds of small lakes, several large lakes, and two substantial streams. At 387 acres, ***Wasilla Lake*** is one of the largest lakes in Southcentral Alaska (*Renshaw Consulting Engineers, 1983*).

The Cottonwood Creek drainage system, of which Wasilla Lake is part, begins northeast of Wasilla and discharges into Knik Arm about 15 miles to the south.

Cottonwood Creek is a popular salmon fishing stream (outside city limits), and has an average rate of flow of about 16 cubic feet per second near the outfall from Wasilla Lake.

At 362 acres, ***Lake Lucille*** is slightly smaller than Wasilla Lake. However, although within close proximity, they are part of two separate drainages and have significantly different characteristics. Lake Lucille is shallow with an average depth of five and a half feet. It's primary water source is springs in the lake bed. No significant creek leads into it and Lucille Creek is a low flow stream that drains it into Big Lake. Water circulation and flushing action through the lake is slow.

Although the quality can vary significantly in a short distance, groundwater supplies are abundant in the area. The Wasilla area has a central water system, and several subdivisions have private water systems. Many homes and businesses in the area, however, rely on individual wells for their water supply. Most of these wells are shallow with depths of less than 100 feet. Static water levels in many of these wells is around 30 feet below the surface. The coarse gravel underlying the Wasilla area provides a large aquifer even in the winter when infiltration is low (*Trainer, 1953*).

Geology and Soils

A lake covered the Susitna River valley lowland during glacial times. The deposition of glacial silts and clays played an important part in the make up of the soils of the area.

Most of the soils in the area provide good sources of sand, gravel, and topsoil. The deposition of silt, clay, and organic muck in old lakes and depressions means that some areas have soil conditions that vary over relatively short distances. The U.S. Soil Conservation Service has mapped seven soil associations in and around Wasilla.

The Homestead and Knik soil types predominate the Wasilla area, with smaller areas of Coal Creek, Jacobsen, Salamatof, and Slikok soil types.

The ***Homestead*** series is common in the Wasilla area especially north of the Parks Highway from the west end of Lake Lucille. Homestead soils are shallow, well-drained silty soils over loose sand and gravel. They have formed on broad out-wash plains and gravel moraines and run from nearly flat terrain to steep areas.

Homestead series is prevalent along Church Road north of the Parks Highway and throughout the Mission Hills subdivision.

The ***Knik*** series is the other major soil type in the area. It includes most of the downtown area, north and south of Lake Lucille and Wasilla Lake.

Knik soils are shallow, well-drained and silty, overlaying coarse, gravelly material, although scattered areas of poorly drained soils are also included. The soils are extensive over a broad range of slopes from flat to steep escarpments.

The ***Coal Creek*** series consists of dark-colored, poorly drained soils that formed in moderately deep silty material over compacted, fine-textured sediments. These soils occur in nearly level to gently sloping stream valleys, on the border of muskegs, and in small depressions. They are sometimes characterized by hillside seeps. This soil unit is found in small areas north and west of the downtown area.

The ***Jacobsen*** series is a very poorly drained, very stony silt loam found in broad depressions. The type is found west of Lake Lucille, south of the railroad, about even with Church Road.

The ***Salamatof*** and ***Slikok*** series are found within low areas and consist of poorly drained, peat, muck and silty sediments in shallow depressions throughout the eastern

side of the city. High water tables, often at or just below the surface, are characteristic of these soils. The banks of Cottonwood Creek south of Wasilla Lake have the greatest concentrations of these soils.

Finally, the ***Wasilla*** series consists of somewhat poorly drained soils with layers of sand and compacted finer material. They do not have the high organic content of the Slikok series. These soils are not extensive in the local area and are most commonly found southeast of Lake Lucille along the Knik-Goose Bay Road (*Wickersham Alaska Corporation, 1986*).

VALLEY MOTORS PUBLIC WATER SOURCE

Valley Motors public water source is a Class B (transient/noncommunity) water source, which is operated by Valley Motors. The source consists of one well located southeast of Black Lake and is at an elevation of approximately 253 feet above sea level. The well is located approximately 1,000 feet southeast of Black Lake, just to the northeast of the intersection of the Parks Highway and Hay Street. (see Map 1 in Appendix A). According to the well log, Valley Motors well penetrates gravel from 0 to 6 feet; gravel and sand from 6 to 10 feet; clay from 10 to 165 feet; and sand, gravel and water from 165 to a total depth of 181 feet below land surface. The well is screened in the confined aquifer from 171 to 181 feet below land surface and had a static water level of 42 feet below land surface at the time of drilling (5/25/94). The well has been capped, but has not been grouted, and is not located in a floodplain. This water system operates year round and serves approximately 18 non-residents through a single connection to the business.

ASSESSMENT AND PROTECTION AREA FOR VALLEY MOTORS DRINKING WATER SOURCE

The Drinking Water Protection and Assessment Area that has been established for Valley Motors is the area that is most sensitive to contamination. This area has served as a basis for assessing the risk of the drinking water source to contamination. This zone around the drinking water source is the most critical area for the preservation of the quality of the drinking water for this source. For simplicity, this area will be known as your Drinking Water Protection Area and will serve as the area of focus for voluntary protection efforts.

An analytical calculation was used to calculate the size and shape of the area that contributes water to the well. The input parameters describing the attributes of the aquifer in this calculation were adopted from the U.S. Geological Survey (*Patrick, Brabets, and Glass, 1989*), and State of Alaska Department of Water Resources (*Jokela et. al., 1991*). This analytical calculation was used as a guide as the first step in establishing the protection area for Valley Motors. Additional methods were further employed to take into account any uncertainties in groundwater flow and aquifer characteristics to arrive at a meaningful and conservative protection area with respect to public health (refer to the Guidance Manual for Class B Public Water Systems for additional information).

The Drinking Water Protection Areas established for wells by the Alaska Department of Environmental Conservation are separated into zones. These zones correspond to a time-of-travel. Time-of-travel is the time required for water to move in the saturated zone of the ground from a specific point to the well. The Drinking Water Protection Areas for the Valley Motors contain four zones: Zone A, Zone B, Zone C, and Zone D (see Map 1 in Appendix B).

Zone A corresponds to the area between the well and the distance equal to ¼ of the distance of the two-year time-of-travel. Depending on where a contaminant source is located within Zone A, travel time for a contaminant to the well may be on the order of several days to several hours.

The Zone B protection area for Valley Motors corresponds to a time-of-travel of less than two years and extends north-northwest towards Merrill Circle.

The Zone C protection area extends from Zone B northwest to Ruth Drive and corresponds to a time-of-travel of less than five years.

The Zone D protection area, which corresponds to a time-of-travel less than ten years, extends from Zone C to the northwest.

INVENTORY OF POTENTIAL AND EXISTING CONTAMINANT SOURCES

The Drinking Water Protection Program has completed an inventory of potential and existing sources of contamination within the Valley Motors Drinking Water Protection Area. This survey was completed through a search of agency records and other publicly available information.

Potential sources of contamination to drinking water supplies cover a wide range of categories and types. Potential drinking water contaminants are found within agricultural, residential, commercial, and industrial areas, but can also occur within areas that have little or no development.

For the basis of this assessment and all Class B public water system assessments, three categories of drinking water contaminants were inventoried. They include:

- Bacteria and viruses;
- Nitrates and/or nitrites; and,
- Volatile organic chemicals.

Inventoried potential sources of contamination within Zone A through Zone D were associated with residential and light industrial type activities (see Table 1 in Appendix C). Below is a summary of the contaminant sources inventoried within the Valley Motors protection area:

- Plastic and synthetic fiber manufacturer;
- Residential septic systems;
- Approximately 23.5 acres of residential area; and
- Activities associated with highways and roads.

These potential contaminant sources present risk for all three categories of drinking water contaminants for the Valley Motors drinking water source.

RANKING OF CONTAMINANT RISKS

Potential and existing sources of contamination have been identified, sorted, and ranked according to what type and level of risk they represent. Ranking of contaminant risks for a "potential" or "existing" source of contamination is a function of toxicity and volumes of specific contaminants associated with that source. Further, contaminant risks are a function of the number and density of those types of contaminant sources as well as the proximity of those sources to the well.

VULNERABILITY OF VALLEY MOTORS DRINKING WATER SOURCES

Vulnerability of a drinking water source to contamination is a combination of two factors:

- Natural susceptibility; and,
- Contaminant risks.

Each of the three categories of drinking water contaminants has been analyzed and an overall vulnerability score of 0 to 100 is ultimately assigned:

Natural Susceptibility (0 – 50 points)

+

Contaminant Risks (0 – 50 points)

=

Vulnerability of the
Drinking Water Source to Contamination (0 – 100).

A score for the Natural Susceptibility is achieved by analyzing the properties of the well and the aquifer.

Susceptibility of the Wellhead (0 – 25 Points)

+

Susceptibility of the Aquifer (0 – 25 Points)

=

Natural Susceptibility (Susceptibility of the Well)
(0 – 50 Points)

The well for Valley Motors was completed in a confined or semi-confined aquifer setting. The aquifer that is utilized by the well is protected from surface contamination by approximately 155 feet of relatively impermeable clay. Combining the susceptibility of the wellhead and the aquifer to contamination leads to a score (0 – 50 points) and rating of Overall Susceptibility (See Appendix D). Table 1 shows the Overall Susceptibility score and rating for Valley Motors.

Table 1. Natural Susceptibility - Susceptibility of the Wellhead and Aquifer to Contamination

	Score	Rating
Susceptibility of the Wellhead	5	Low
Susceptibility of the Aquifer	8	Low
Natural Susceptibility	13	Low

Contaminant risks to a drinking water source depend on the type, number or density, and distribution of contaminant sources. The plastic and synthetic fiber manufacturer contributes the highest risk for potential contamination to the Valley Motors source of public drinking water.

A score (0 – 50 points) and rating of Contaminant Risks (see Appendix D) is assigned based on the findings of the Contaminant Source Inventory (Appendix C - Table 1 – Table 4). This portion of the analysis examines any existing or historical contamination that has been detected at the drinking water source through routine sampling. It also reviews contamination that has or may have occurred, but has not arrived or been detected at the well. Table 2 summarizes the Contaminant Risks for each category of drinking water contaminants.

Table 2. Contaminant Risks

Contaminant Risks	Score	Rating
Bacteria and Viruses	13	Low
Nitrates and/or Nitrites	15	Low
Volatile Organic Chemicals	44	Very High

Appendix D contains eight charts, which together form the 'Vulnerability Analysis' for a source water assessment for a public drinking water source. Chart 1 analyzes the 'Susceptibility of the Wellhead' to contamination by looking at the construction of the well and its surrounding area. Chart 2 analyzes the 'Susceptibility of the Aquifer' to contamination by looking at the naturally occurring attributes of the water source and influences on the groundwater system that might lead to contamination. Chart 3 analyzes 'Contaminant Risks' for the drinking water source with respect to bacteria and viruses. The 'Contaminant Risks' portion of the analysis considers potential sources of contaminants as well as a review of contamination that has or may have occurred, but has not arrived or been detected at the well. Lastly, Chart 4 contains the 'Vulnerability Analysis for Bacteria and Viruses'. Charts 5 through 8 contain the Contaminant Risks and Vulnerability Analyses for nitrates and nitrites and volatile organic chemicals, respectively.

Vulnerability of the drinking water source to contamination is the combination of susceptibility of the aquifer and the well with contaminant risks. Table 3 contains the overall vulnerability scores (0 – 10) and ratings for each of the three categories of drinking water contaminants (see Appendix D). Note: scores are rounded off to the nearest five.

Table 3. Overall Vulnerability of Valley Motors Public Drinking Water Source to Contamination by Category

Category	Score	Rating
Bacteria and Viruses	25	Low
Nitrates and Nitrites	30	Low
Volatile Organic Chemicals	55	Medium

Tables 2 through 4 in Appendix C contain the ranking of potential and existing sources of contamination with respect to bacteria and viruses, nitrates and/or nitrites, and volatile organic chemicals.

The residential septic systems and activities associated with highways and roads are the driving factors in determining contaminant risks for bacteria and viruses, and nitrates and nitrites; and the plastic and synthetic fiber manufacturer in Zone C is the driving factor in determining contaminant risks for volatile organic chemicals (see "Overall Rank after Analysis" in Table 2 – 4 of Appendix C).

Overall, contaminant risks for bacteria and viruses are low with residential septic systems driving the score. Combining this potential bacteria and viruses risk with the susceptibility of the well yields an overall vulnerability to contamination of low for this source of public drinking water.

Overall, contaminant risks for nitrates and/or nitrites are low with residential septic systems driving the score. Combining this potential nitrates and/or nitrites risk with the susceptibility of the well yields an overall vulnerability to contamination of low for this source of public drinking water.

Overall, contaminant risks for volatile organic chemicals are medium with the plastic and synthetic fiber manufacturer driving the score. Combining these potential volatile organic chemicals contamination risks with the susceptibility of the well yields an overall vulnerability to contamination of medium for this source of public drinking water.

SUMMARY

A *Source Water Assessment* has been completed for the Valley Motors source of public drinking water. The overall vulnerability of this source to contamination is **Low** for bacteria and viruses, **Low** for nitrates and/or nitrites, and **Medium** for volatile organic chemicals. This assessment of contaminant risks can be used as a foundation for local voluntary protection efforts as well as a basis for the continuous efforts on the part of the Anchorage Water & Wastewater Utility to protect public health. It is anticipated that *Source Water Assessments* will be updated every five years to reflect any changes in the vulnerability and/or susceptibility of the public drinking water source.

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APPENDIX A

Drinking Water Protection Area

Drinking Water Protection Area for the Public Water System Well at Valley Motors

2000 0 2000 4000 Feet

Legend

- Public Water System Well
- Roads
- Lakes

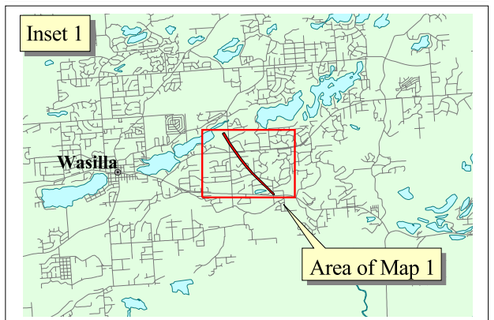
Protection Areas

- Zone A
  - Several Months Travel Time
- Zone B
  - Less Than 2 Years Travel Time
- Zone C
  - Less Than 5 Years Travel Time
- Zone D
  - Less Than 10 Years Travel Time

Data Sources:
Base Map Data, Contaminant Sources, Public Water System Wells
Alaska Department of Environmental Conservation (ADEC)

Drinking Water Protection Areas based on ADEC
Calculation Spreadsheet.

URS Corporation does not guarantee the accuracy or validity of the data provided.

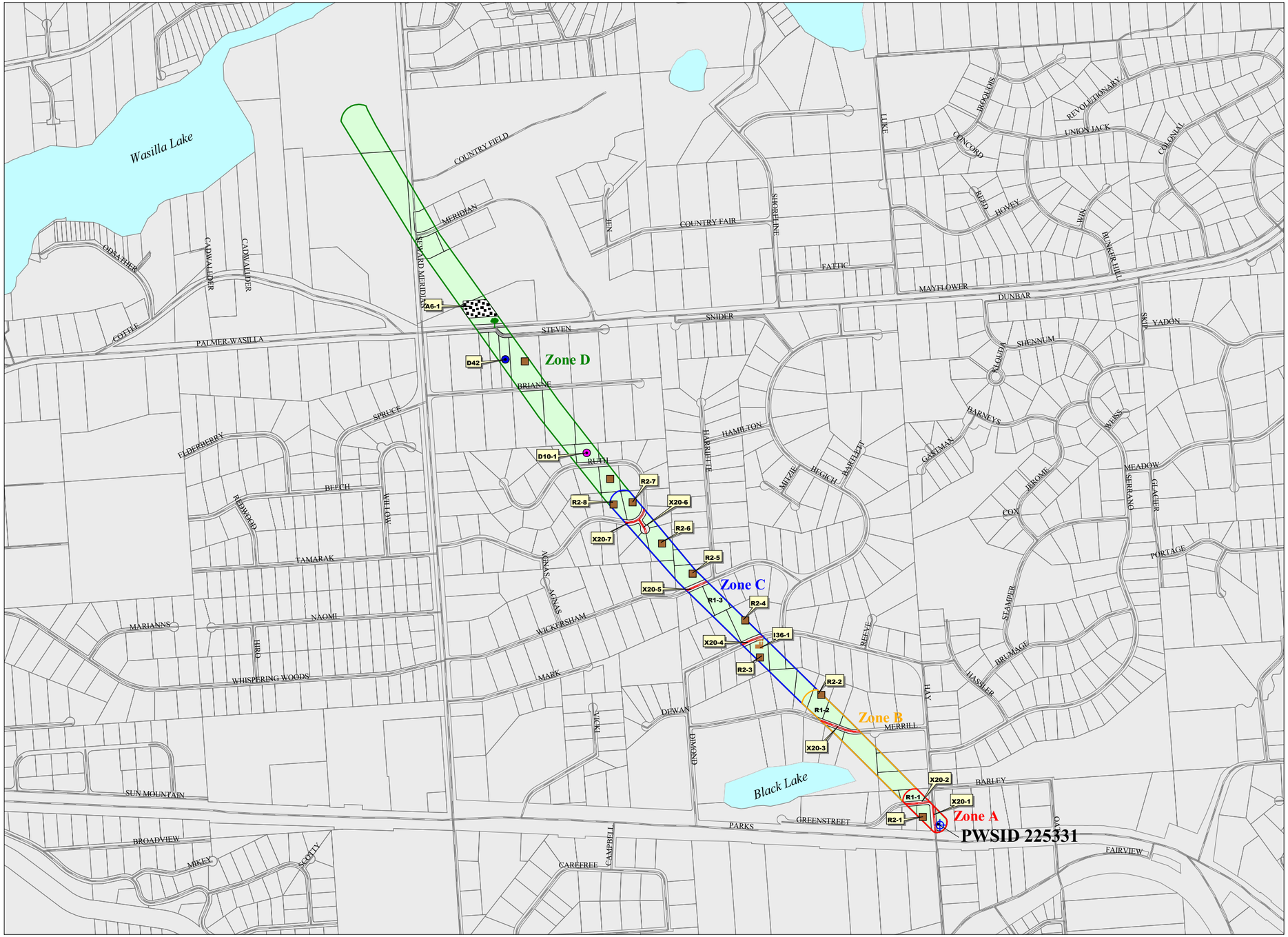


Appendix A MAP 1 **PWS 225331.001**

APPENDIX B

Drinking Water Protection Area Showing Sources of Contamination

Drinking Water Protection Area for the Public Water System Well at Valley Motors
Showing Potential and Existing Sources of Contamination



Legend

- Public Water System Well
- Roads
- Lakes

Protection Areas

- Zone A — Several Months Travel Time
- Zone B — Less Than 2 Years Travel Time
- Zone C — Less Than 5 Years Travel Time
- Zone D — Less Than 10 Years Travel Time

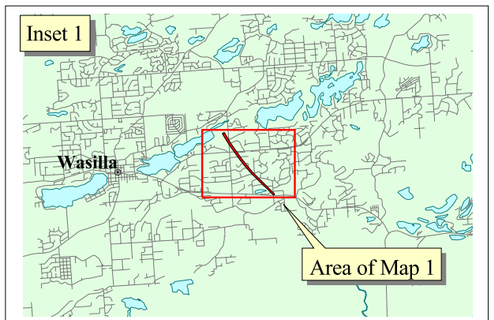
Contaminant Sources

- Orchards or nurseries (A10)
- Plastics and synthetic fibers manufacturing (I36)
- Injection wells (Class V) Septic System (Drainfield) (D10)
- Injection wells (Class V) Vehicle Waste Disposal (D42)
- Septic systems (R2)
- Sewer Lines (D1)
- Highways and Roads (X20)
- Residential Areas (R1)
- Livestock Feedlot (A6)

Data Sources:
Base Map Data, Contaminant Sources, Public Water System Wells
Alaska Department of Environmental Conservation (ADEC)

Drinking Water Protection Areas based on ADEC
Calculation Spreadsheet.

URS Corporation does not guarantee the accuracy or validity of the data provided.



Appendix B MAP 1 **PWS 225331.001**

APPENDIX C

Contaminant Source Inventory Tables

Table 1

Contaminant Source Inventory for the Class 'B' Well System at Valley Motors

PWSID 225331

Contaminant Source Category	Contaminant Source ID	CS ID Tag	Zone	Location	Map	Comments
Residential Areas	R1	R1-1	A		1	Total Acreage 1.5
Septic systems (serves one single-family home)	R2	R2-01	A	GREENSTREET CIR	1	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	S HAY ST	1	
Highways and roads, paved (cement or asphalt)	X20	X20-02	A	E GREENSTREET CIR	1	
Residential Areas	R1	R1-2	B		1	Total Acreage 7
Septic systems (serves one single-family home)	R2	R2-02	B	MERRILL CIR	1	
Highways and roads, paved (cement or asphalt)	X20	X20-03	B	E MERRILL CIR	1	
Plastics and synthetic fibers manufacturing	I36	I36-01	C	DIMOND WAY	1	
Residential Areas	R1	R1-3	C		1	Total Acreage 15
Septic systems (serves one single-family home)	R2	R2-03	C	DIMOND WAY	1	
Septic systems (serves one single-family home)	R2	R2-04	C	DIMOND WAY	1	
Septic systems (serves one single-family home)	R2	R2-05	C	WICKERSHAM WAY	1	
Septic systems (serves one single-family home)	R2	R2-06	C	PASS THE BUCK CIR	1	
Septic systems (serves one single-family home)	R2	R2-07	C	RUTH DR	1	
Residential Areas	R1	R2-08	C	RUTH DR	1	
Highways and roads, paved (cement or asphalt)	X20	X20-04	C	E DIMOND WAY	1	
Highways and roads, paved (cement or asphalt)	X20	X20-05	C	E WICKERSHAM WAY	1	
Highways and roads, paved (cement or asphalt)	X20	X20-06	C	S PASS THE BUCK CIR	1	
Highways and roads, paved (cement or asphalt)	X20	X20-07	C	E RUTH DR	1	
Livestock feedlots	A6	A6-01	D	PALMER-WASILLA HWY	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	D	RUTH DR	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-01	D	BRIANNE LN	1	

Table 2

Potential and Existing Sources of Contamination for Valley Motors (Bacteria and Viruses)

PWSID 225331

Contaminant Source Category	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank after Analysis	Location	Map	Comments
Residential Areas	R1	R1-1	A	Low	1		1	
Septic systems (serves one single-family home)	R2	R2-01	A	Low	2	GREENSTREET CIR	1	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	3	S HAY ST	1	
Highways and roads, paved (cement or asphalt)	X20	X20-02	A	Low	4	E GREENSTREET CIR	1	
Residential Areas	R1	R1-2	B	Low	5		1	
Septic systems (serves one single-family home)	R2	R2-02	B	Very Low	6	MERRILL CIR	1	
Highways and roads, paved (cement or asphalt)	X20	X20-03	B	Very Low	7	E MERRILL CIR	1	
Residential Areas	R1	R1-3	C	Low			1	
Septic systems (serves one single-family home)	R2	R2-03	C	Very Low		DIMOND WAY	1	
Septic systems (serves one single-family home)	R2	R2-04	C	Very Low		DIMOND WAY	1	
Septic systems (serves one single-family home)	R2	R2-05	C	Very Low		WICKERSHAM WAY	1	
Septic systems (serves one single-family home)	R2	R2-06	C	Very Low		PASS THE BUCK CIR	1	
Septic systems (serves one single-family home)	R2	R2-07	C	Very Low		RUTH DR	1	
Residential Areas	R1	R2-08	C	Low		RUTH DR	1	
Highways and roads, paved (cement or asphalt)	X20	X20-04	C	Very Low		E DIMOND WAY	1	
Highways and roads, paved (cement or asphalt)	X20	X20-05	C	Very Low		E WICKERSHAM WAY	1	
Highways and roads, paved (cement or asphalt)	X20	X20-06	C	Very Low		S PASS THE BUCK CIR	1	
Highways and roads, paved (cement or asphalt)	X20	X20-07	C	Very Low		E RUTH DR	1	
Livestock feedlots	A6	A6-01	D	High		PALMER-WASILLA HWY	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	D	High		RUTH DR	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-01	D	Low		BRIANNE LN	1	

Table 3

Potential and Existing Sources of Contamination for Valley Motors (Nitrates and Nitrites)

PWSID 225331

Contaminant Source Category	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank after Analysis	Location	Map	Comments
Residential Areas	R1	R1-1	A	Low	1		1	
Septic systems (serves one single-family home)	R2	R2-01	A	Low	2	GREENSTREET CIR	1	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	3	S HAY ST	1	
Highways and roads, paved (cement or asphalt)	X20	X20-02	A	Low	4	E GREENSTREET CIR	1	
Residential Areas	R1	R1-2	B	Low	5		1	
Septic systems (serves one single-family home)	R2	R2-02	B	Very Low	9	MERRILL CIR	1	
Highways and roads, paved (cement or asphalt)	X20	X20-03	B	Very Low	10	E MERRILL CIR	1	
Plastics and synthetic fibers manufacturing	I36	I36-01	C	Low	6	DIMOND WAY	1	
Residential Areas	R1	R1-3	C	Low	7		1	
Septic systems (serves one single-family home)	R2	R2-03	C	Very Low		DIMOND WAY	1	
Septic systems (serves one single-family home)	R2	R2-04	C	Very Low		DIMOND WAY	1	
Septic systems (serves one single-family home)	R2	R2-05	C	Very Low		WICKERSHAM WAY	1	
Septic systems (serves one single-family home)	R2	R2-06	C	Very Low		PASS THE BUCK CIR	1	
Septic systems (serves one single-family home)	R2	R2-07	C	Very Low		RUTH DR	1	
Residential Areas	R1	R2-08	C	Low	8	RUTH DR	1	
Highways and roads, paved (cement or asphalt)	X20	X20-04	C	Very Low		E DIMOND WAY	1	
Highways and roads, paved (cement or asphalt)	X20	X20-05	C	Very Low		E WICKERSHAM WAY	1	
Highways and roads, paved (cement or asphalt)	X20	X20-06	C	Very Low		S PASS THE BUCK CIR	1	
Highways and roads, paved (cement or asphalt)	X20	X20-07	C	Very Low		E RUTH DR	1	
Livestock feedlots	A6	A6-01	D	High		PALMER-WASILLA HWY	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	D	High		RUTH DR	1	

Table 4

Potential and Existing Sources of Contamination for Valley Motors (Volatile Organic Chemicals - VOCs)

PWSID 225331

Contaminant Source Category	Contaminant Source ID	CS ID Tag	Zone	Risk Ranking for Analysis	Overall Rank after Analysis	Location	Map	Comments
Residential Areas	R1	R1-1	A	Low	1		1	
Septic systems (serves one single-family home)	R2	R2-01	A	Low	2	GREENSTREET CIR	1	
Highways and roads, paved (cement or asphalt)	X20	X20-01	A	Low	3	S HAY ST	1	
Highways and roads, paved (cement or asphalt)	X20	X20-02	A	Low	4	E GREENSTREET CIR	1	
Residential Areas	R1	R1-2	B	Low	5		1	
Septic systems (serves one single-family home)	R2	R2-02	B	Very Low	8	MERRILL CIR	1	
Highways and roads, paved (cement or asphalt)	X20	X20-03	B	Very Low	9	E MERRILL CIR	1	
Plastics and synthetic fibers manufacturing	I36	I36-01	C	Very High		DIMOND WAY	1	
Residential Areas	R1	R1-3	C	Low	6		1	
Septic systems (serves one single-family home)	R2	R2-03	C	Very Low	10	DIMOND WAY	1	
Septic systems (serves one single-family home)	R2	R2-04	C	Very Low		DIMOND WAY	1	
Septic systems (serves one single-family home)	R2	R2-05	C	Very Low		WICKERSHAM WAY	1	
Septic systems (serves one single-family home)	R2	R2-06	C	Very Low		PASS THE BUCK CIR	1	
Septic systems (serves one single-family home)	R2	R2-07	C	Very Low		RUTH DR	1	
Residential Areas	R1	R2-08	C	Low	7	RUTH DR	1	
Highways and roads, paved (cement or asphalt)	X20	X20-04	C	Very Low		E DIMOND WAY	1	
Highways and roads, paved (cement or asphalt)	X20	X20-05	C	Very Low		E WICKERSHAM WAY	1	
Highways and roads, paved (cement or asphalt)	X20	X20-06	C	Very Low		S PASS THE BUCK CIR	1	
Highways and roads, paved (cement or asphalt)	X20	X20-07	C	Very Low		E RUTH DR	1	
Livestock feedlots	A6	A6-01	D	Low		PALMER-WASILLA HWY	1	
Injection wells (Class V) Large-Capacity Septic System (Drainfield Disposal Method)	D10	D10-01	D	Low		RUTH DR	1	
Injection wells (Class V) Motor Vehicle Waste Disposal Well	D42	D42-01	D	High		BRIANNE LN	1	

APPENDIX D

Vulnerability Analysis Charts and Tables

Chart 1. Susceptibility of the wellhead – Valley Motors

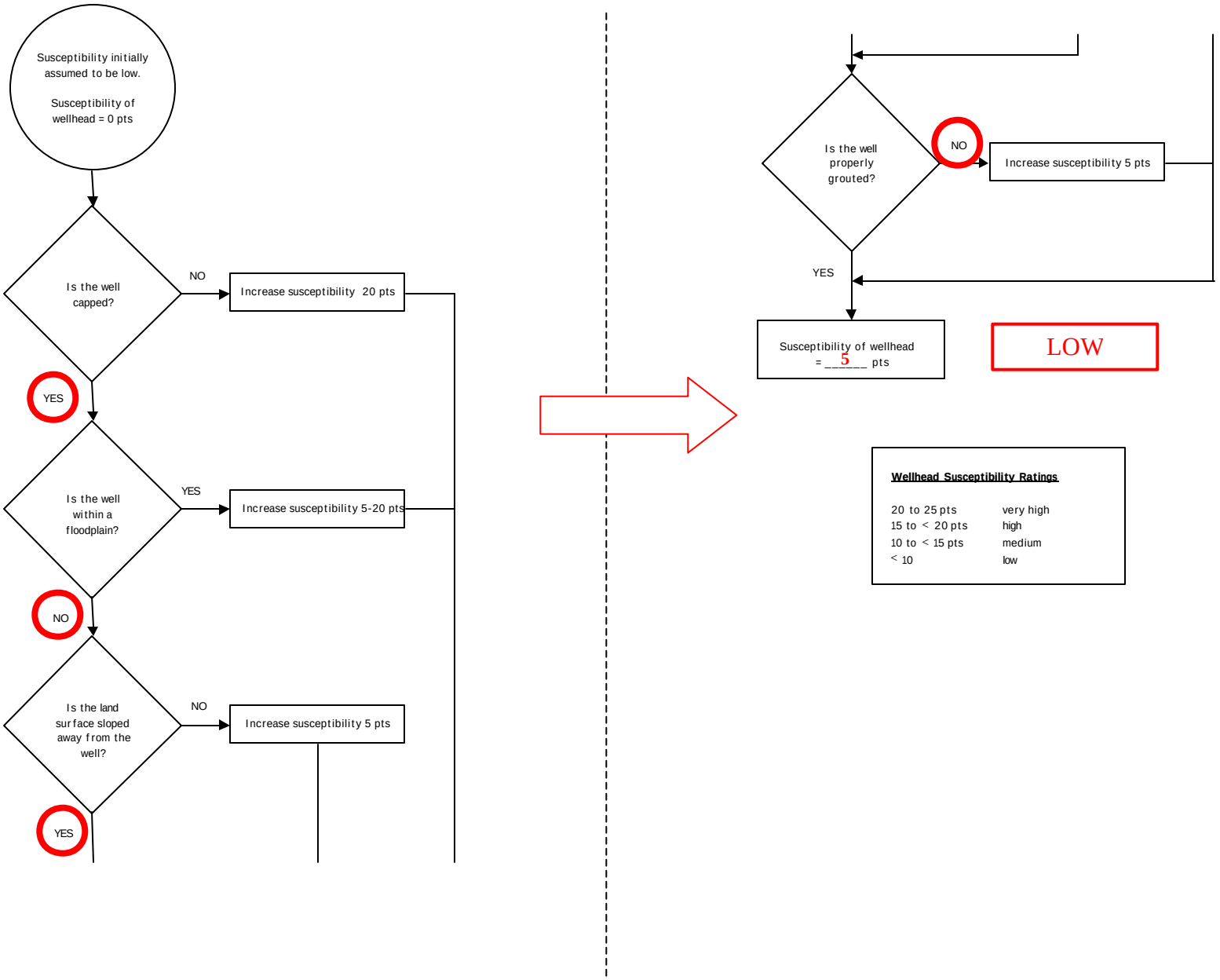
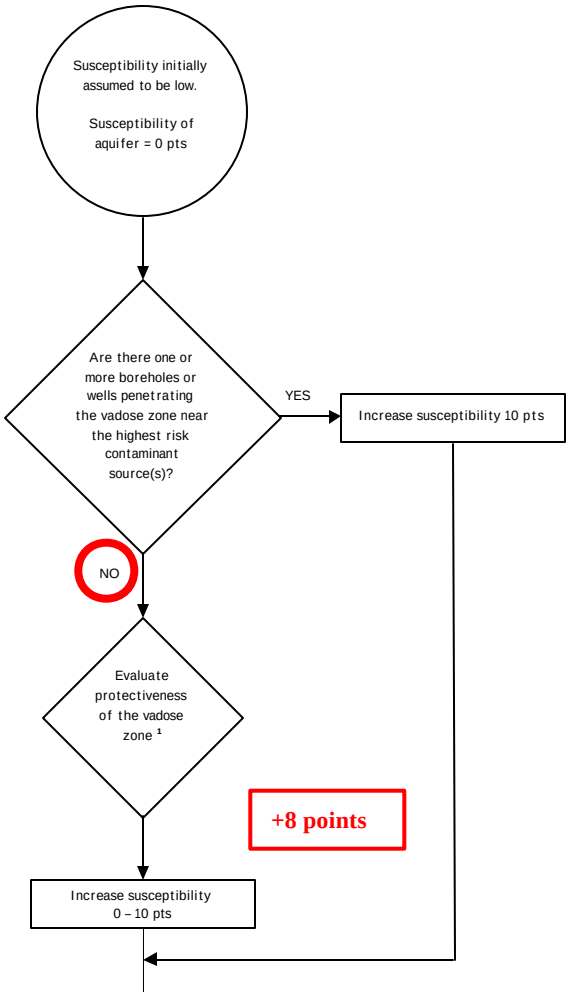
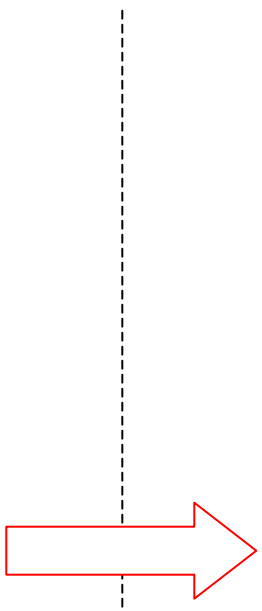
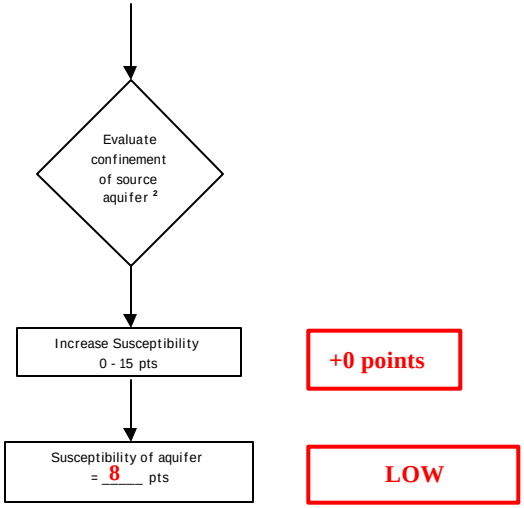


Chart 2. Susceptibility of the aquifer – Valley Motors







1. Protectiveness of the Vadose Zone

- net recharge (function of precipitation, slope of land surface, & permeability of soils)
  [0 – 10 pts; 50% weight]
- depth to water table (unconfined aquifer) or top of confining layer (confined aquifer)
  [interpolate linearly: 100' – 20', 0 – 5 pts; 20' – 0', 5 – 10 pts; 50% weight]

Recharge (18" per year, Gravel, and Flat Interior Slope)
8/10 Pts = 4 Points

Depth to top of confining layer is 10'.
8/10 Pts = 4 Points

Protectiveness of the Vadose Zone Total = 8 Points

2. Degree of Confinement

- confined verses unconfined aquifer
  [confined: K $\leq 10^{-6}$ cm/s, minimum thickness of at least one layer = 20 ft, interpolate linearly 100' – 20', 0 – 10 pts; unconfined = 15 pts; 65% weight]
- density of boreholes and wells penetrating the confining layer (confined aquifer) or the water table (unconfined aquifer)
  [confined: 0 – 15 pts; unconfined = 15 pts; 35% weight]

Confinement (155' of collective clay, 155' maximum thickness)
0/15 Pts = 0 Points

Density of boreholes/wells
0/15 Pts = 0 Points

Degree of Confinement
Total = 0 Points

Aquifer Susceptibility Ratings

20 to 25 pts	very high
15 to < 20 pts	high
10 to < 15 pts	medium
< 10	low

LOW

Chart 3. Contaminant risks for Valley Motors – Bacteria & Viruses

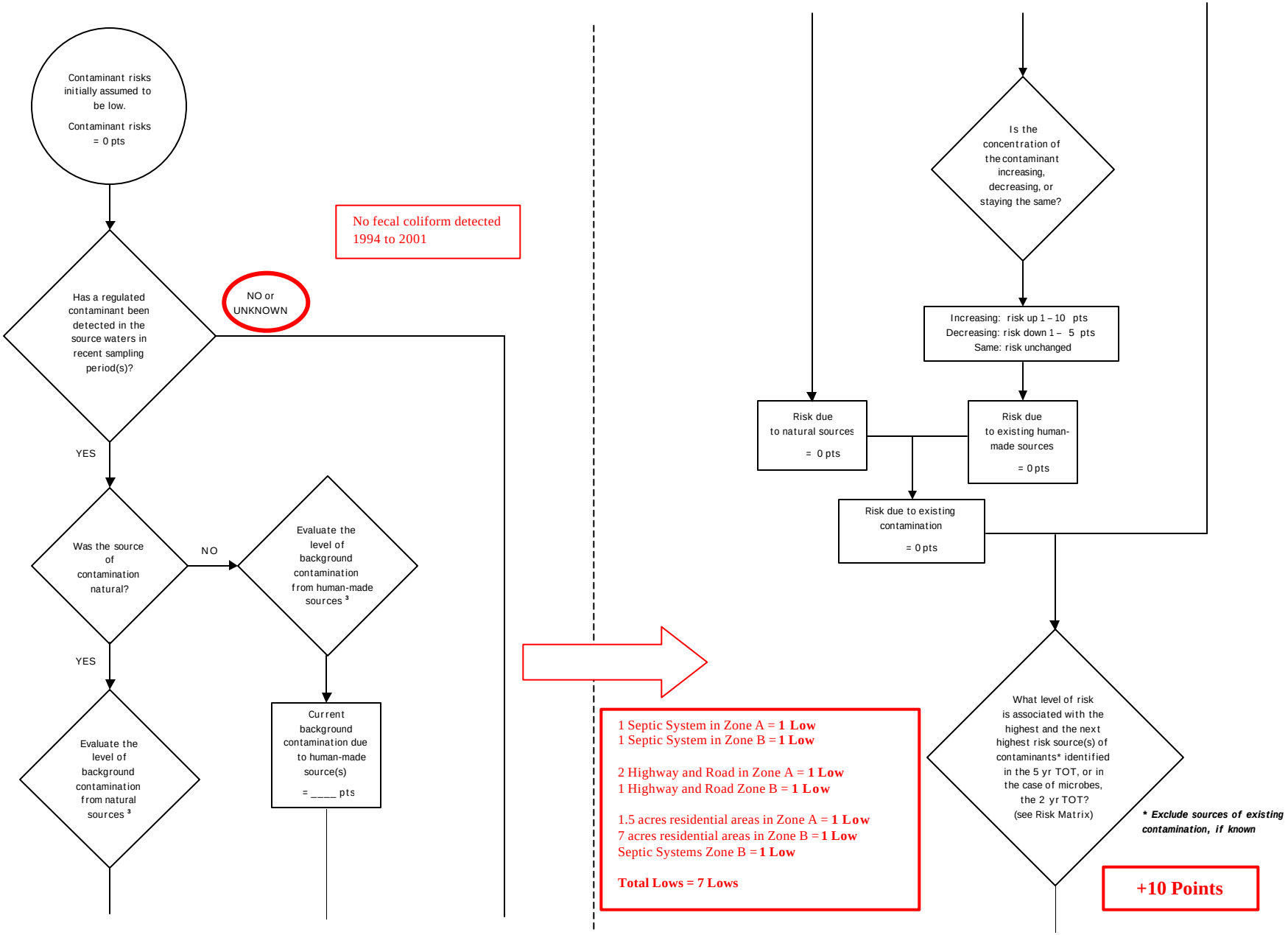


Chart 3. Contaminant risks for Valley Motors – Bacteria & Viruses (Continued)

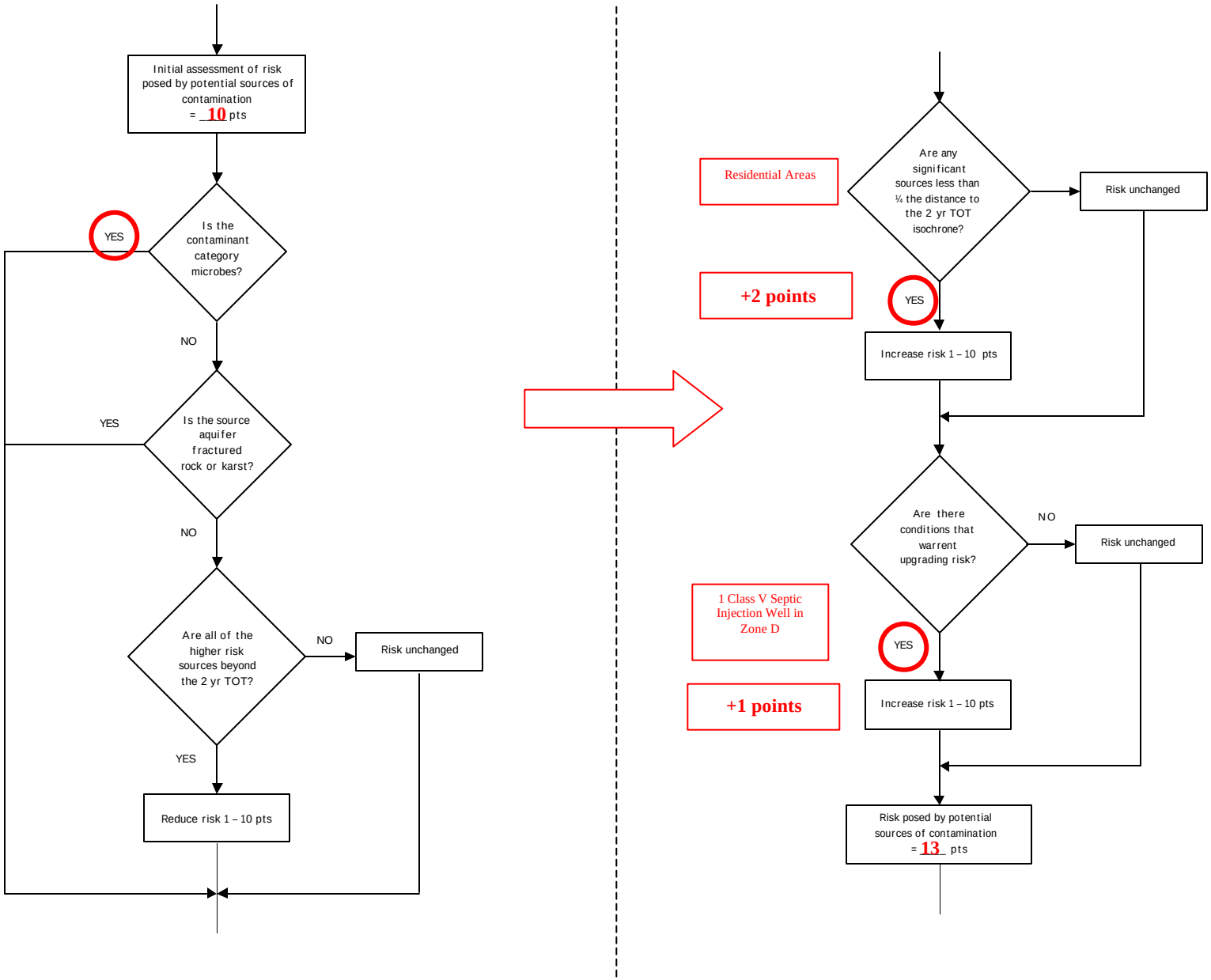
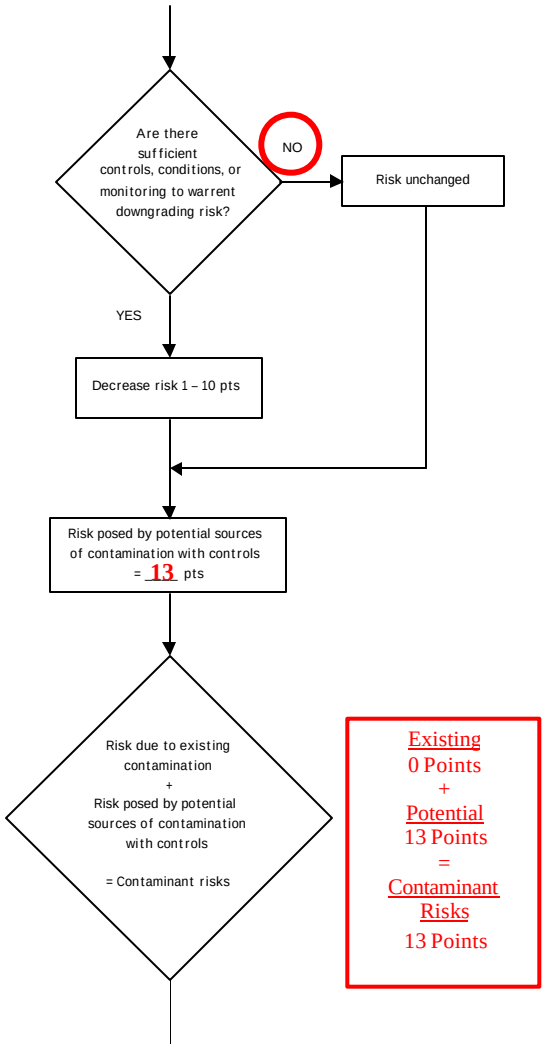


Chart 3. Contaminant risks for Valley Motors – Bacteria & Viruses (Continued)



Existing
0 Points
+
Potential
13 Points
=
Contaminant Risks
13 Points

**** Truncate risk at 50 pts***

Contaminant risks*
= 13 pts

LOW

3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 MCL	0 - 5 pts

Contaminant Risk Ratings

40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
< 20	low

Table 1. Risk Matrix for Contaminant Sources for Valley Motors – Bacteria & Viruses

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)	See Chart 3	LOW 10 pts	MEDIUM 20 pts	HIGH 30 pts	VERY HIGH 40 pts
Low	≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	---
Medium	---	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
High	---	---	1 source + 10 pts	≥ 2 sources + 10 pts
Very High	---	---	---	1 source + 10 pts

Chart 4. Vulnerability analysis for Valley Motors – Bacteria & Viruses

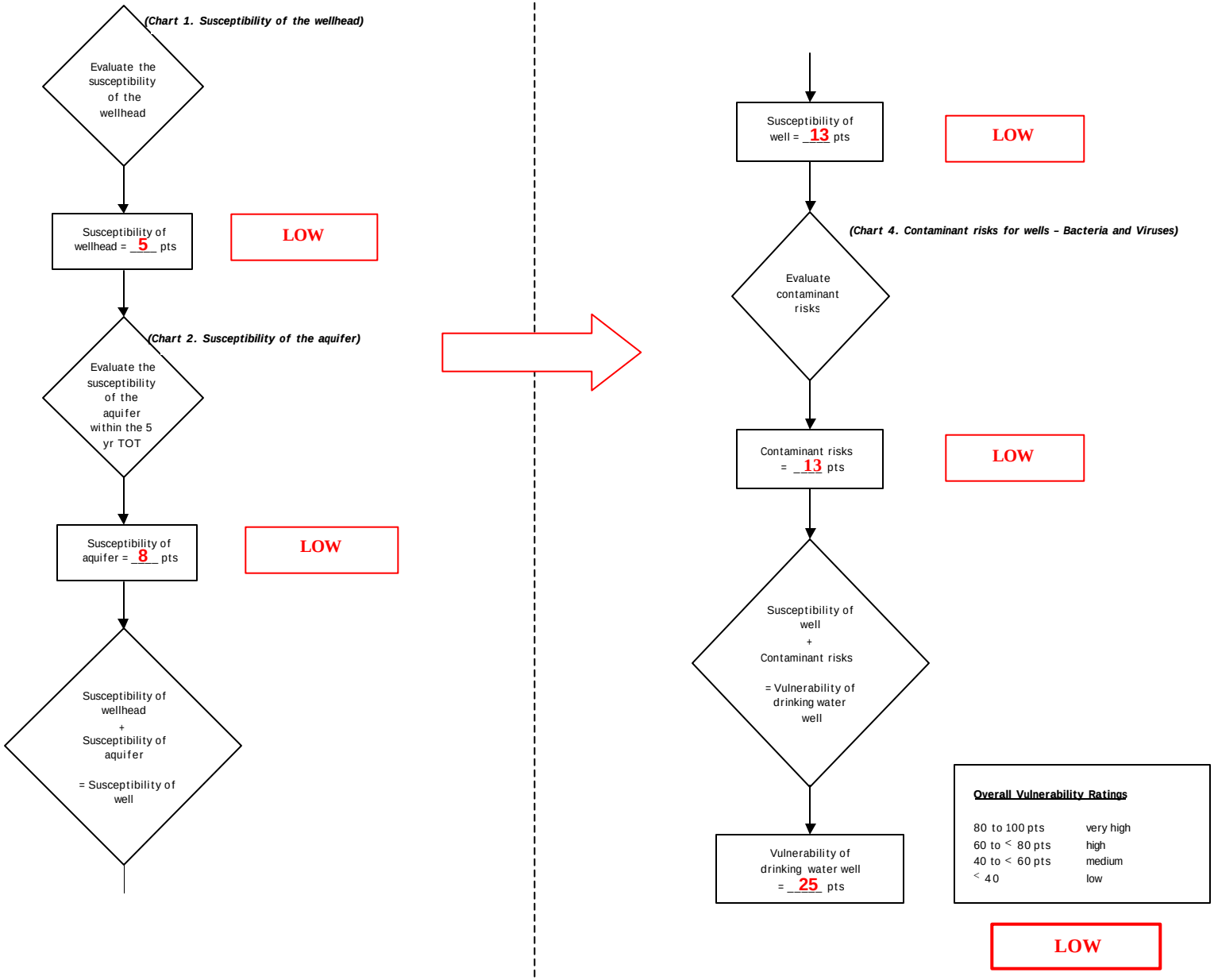


Chart 5. Contaminant risks for Valley Motors – Nitrates and Nitrites

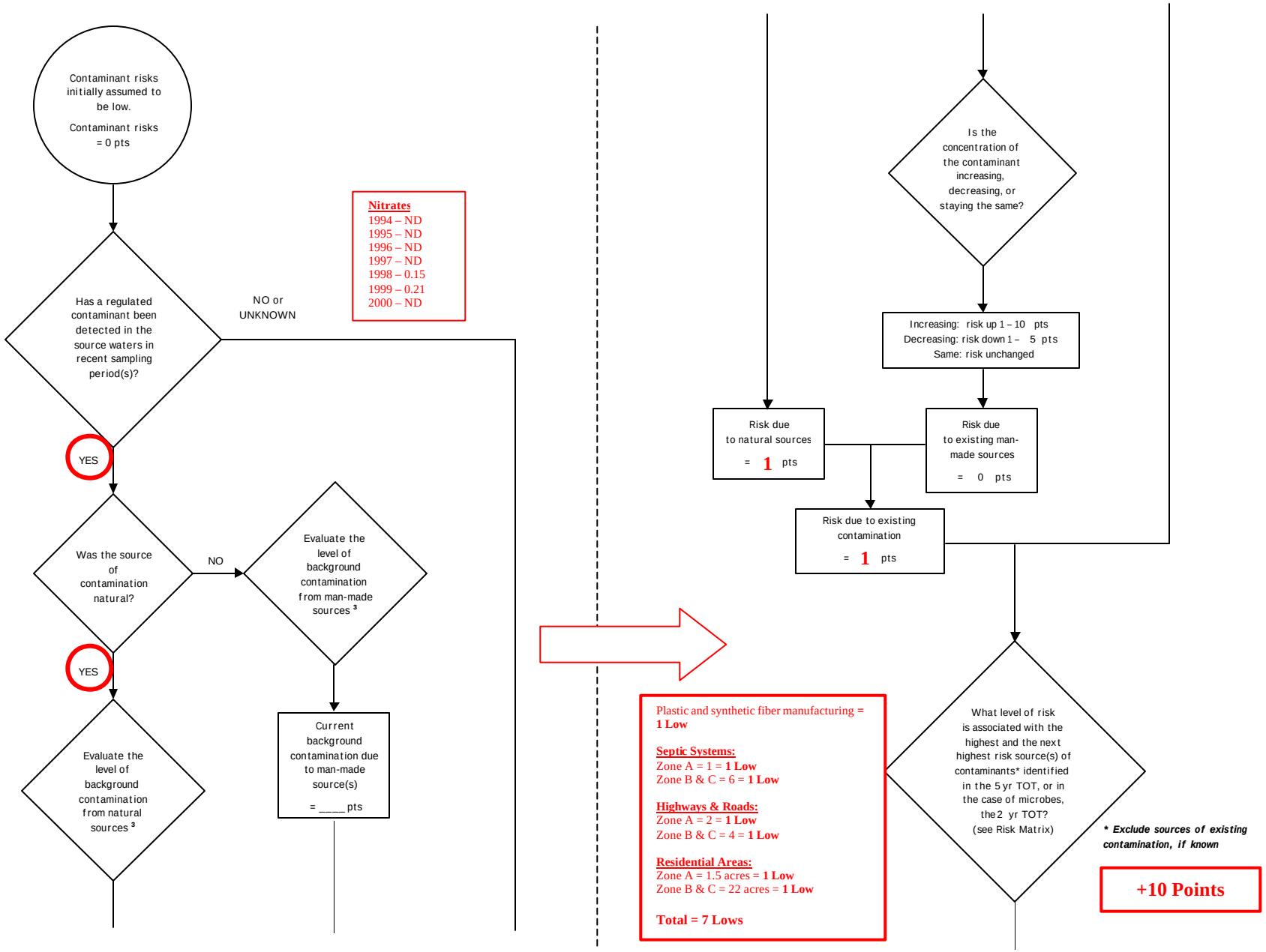


Chart 5. Contaminant risks for Valley Motors – Nitrates and Nitrites (Continued)

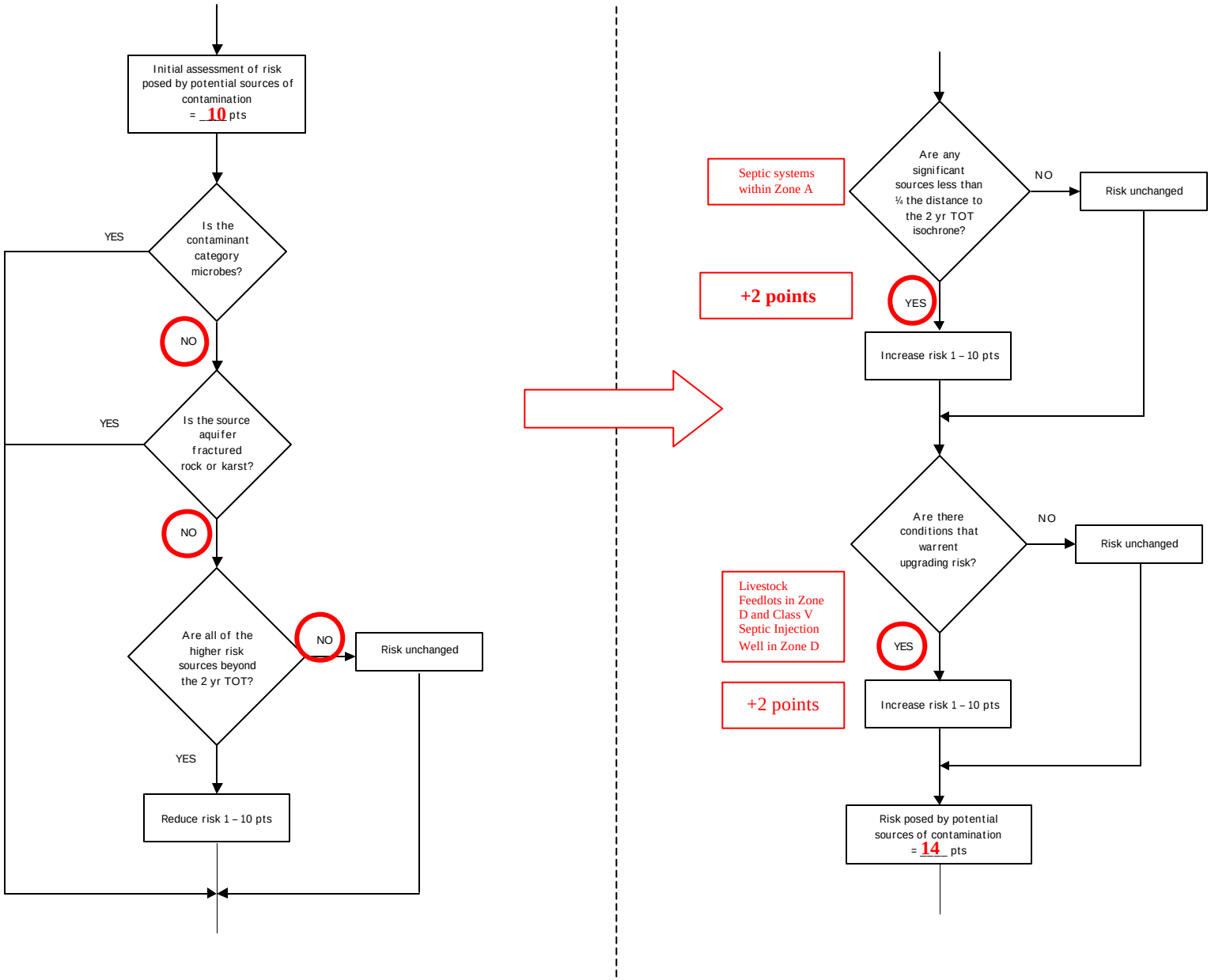
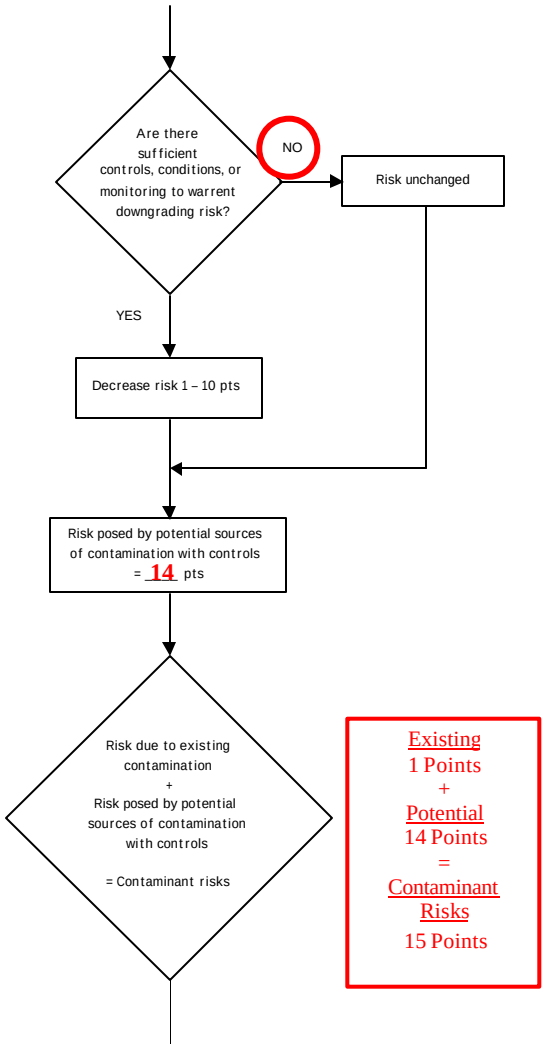


Chart 5. Contaminant risks for Valley Motors – Nitrates and Nitrites (Continued)



Existing
1 Points
+
Potential
14 Points
=
Contaminant Risks
15 Points

* *Truncate risk at 50 pts*

Contaminant risks*
= 15 pts

LOW

3. Level of Background Contamination

> MCL	50 pts
0.5 MCL to < MCL	20 pts
0.2 MCL to < 0.5 MCL	10 pts
'detect' to < 0.2 MCL	5 pts

Contaminant Risk Ratings

40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
< 20	low

Nitrates
ND on 12/06/00
0.21 mg/L on 8/18/99
0.15 mg/L on 8/25/98
ND on 8/05/97
ND on 5/15/96
ND on 11/09/95
ND on 9/01/94

Maximum Contaminant Level (MCL)
= 10mg/L
0.21 mg/L / 10 mg/L
= 0.021 of MCL

+1 Points

Table 2. Risk Matrix for Contaminant Sources for Valley Motors – Nitrates and Nitrites

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)	Plastic manufacturing, 23.5 acres of residential area, septic systems and highways and roads	**LOW 10 pts**	**MEDIUM 20 pts**	**HIGH 30 pts**	**VERY HIGH 40 pts**
Low		> 10 sources + 10 pts	> 10 sources + 5 pts	> 20 sources + 5 pts	---
Medium		---	> 2 sources + 5 pts	> 5 sources + 5 pts	> 10 sources + 5 pts
High		---	---	1 source + 10 pts	> 2 sources + 10 pts
Very High		---	---	---	1 source + 10 pts

Chart 6. Vulnerability analysis for Valley Motors – Nitrates and Nitrites

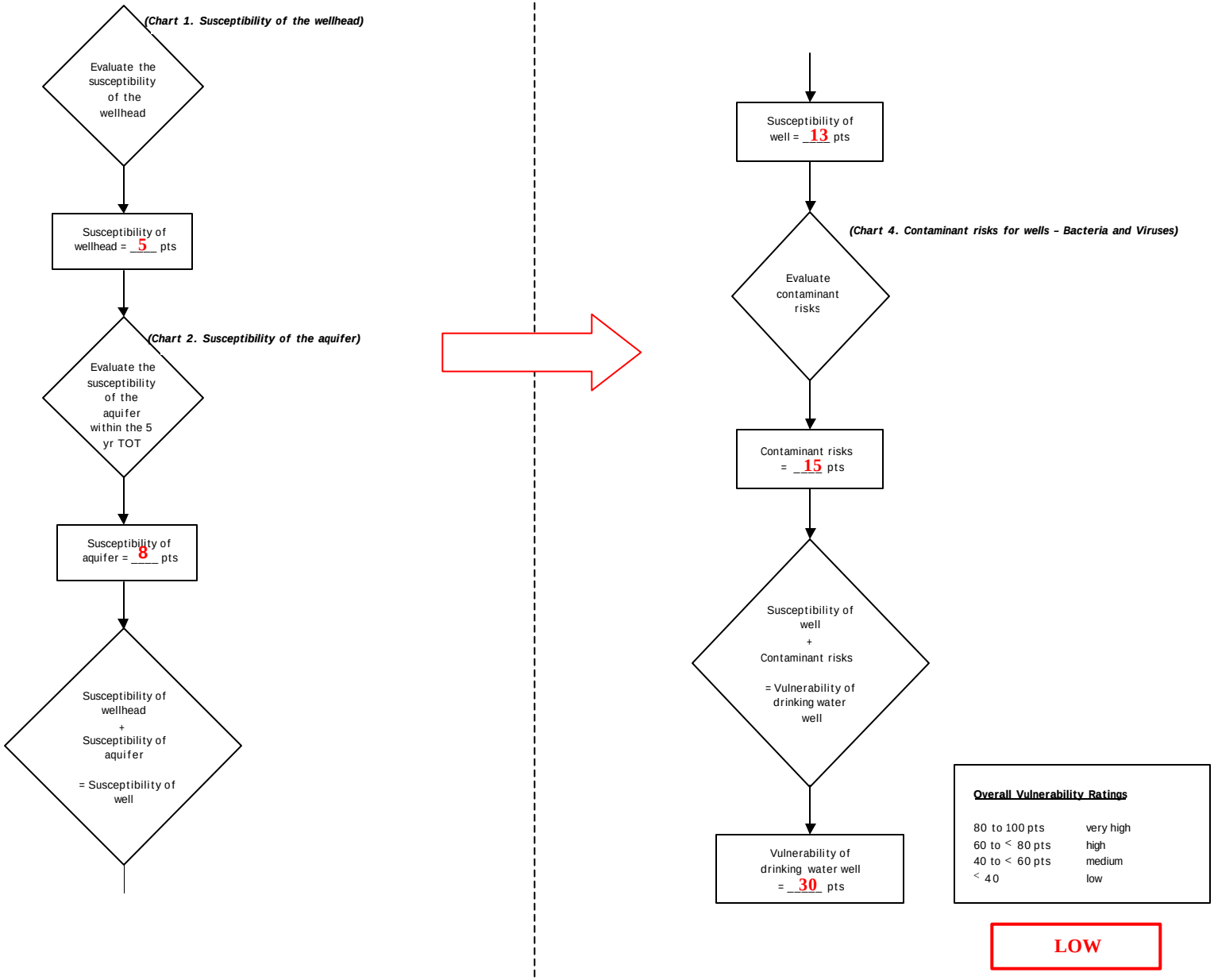


Chart 7. Contaminant risks for Valley Motors – Volatile Organic Chemicals

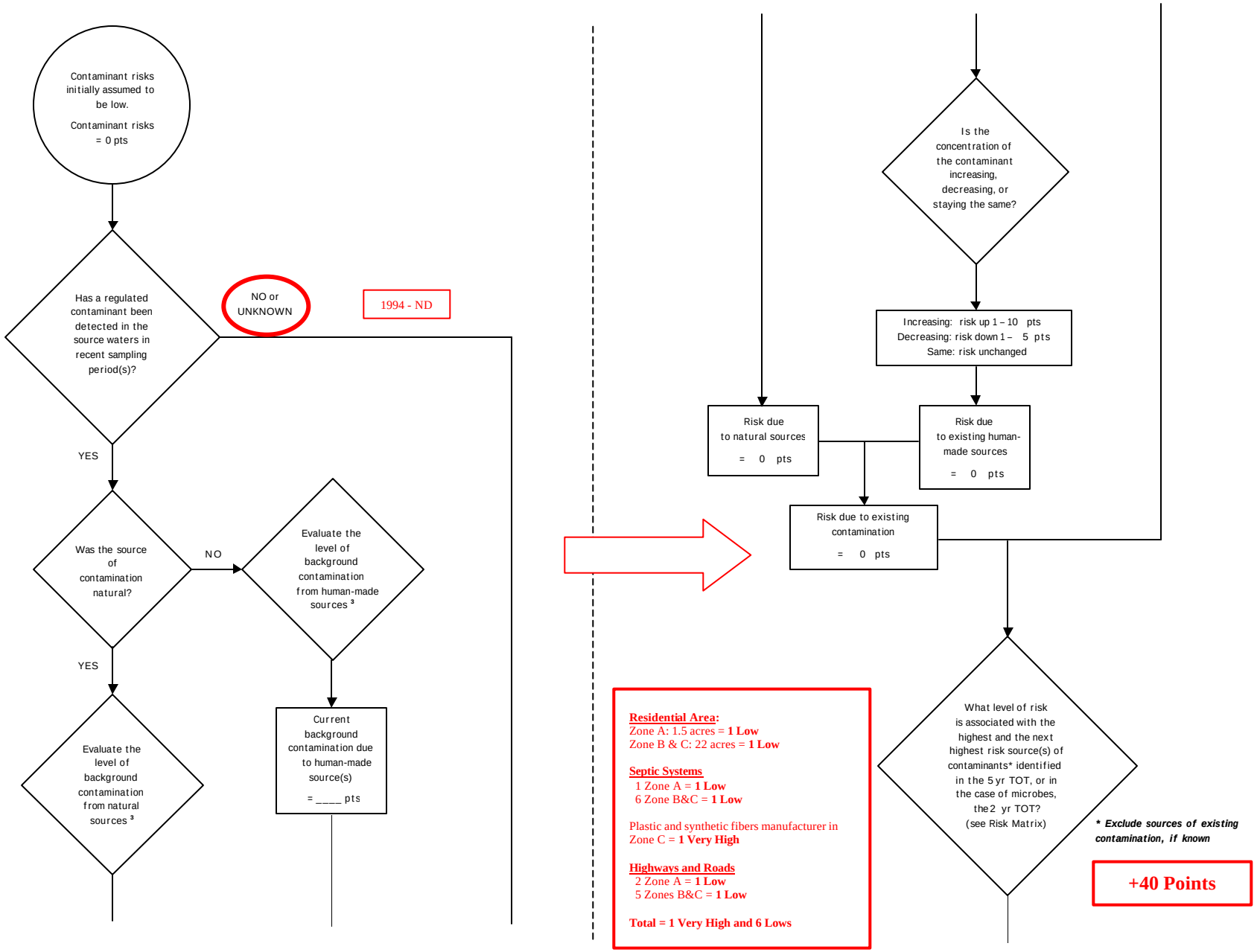


Chart 7. Contaminant risks for Valley Motors – Volatile Organic Chemicals

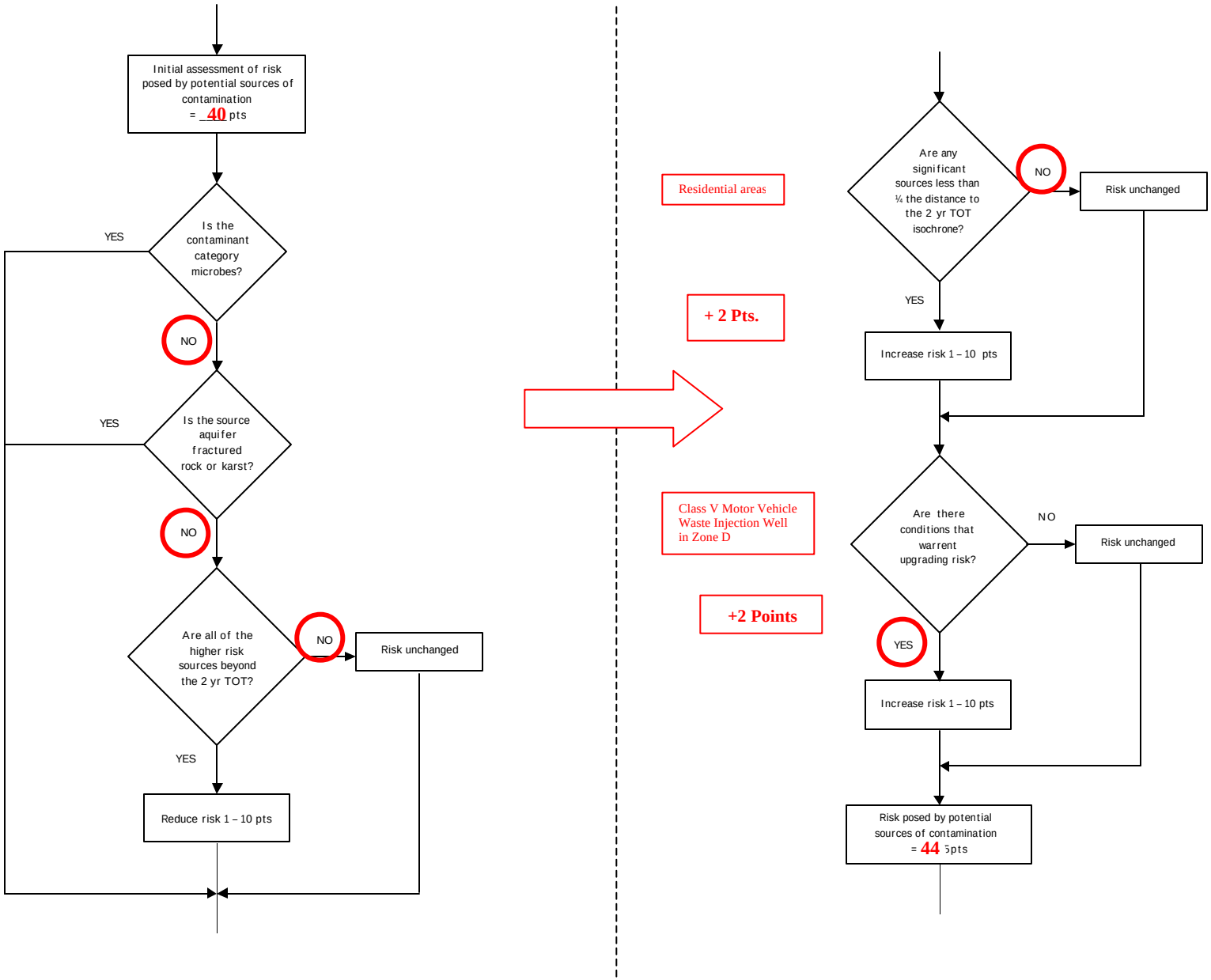
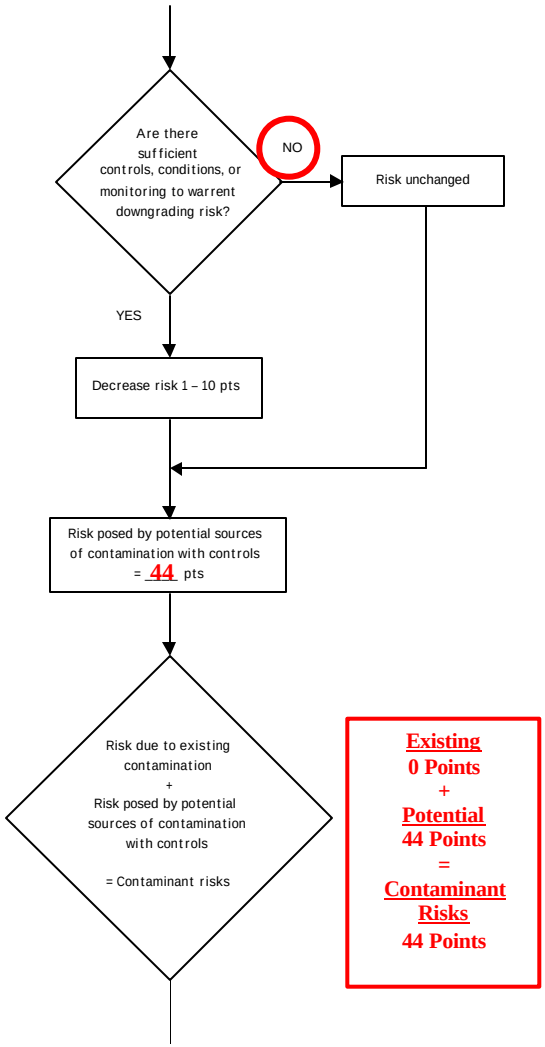


Chart 7. Contaminant risks for Valley Motors – Volatile Organic Chemicals (Continued)



Existing
0 Points
+
Potential
44 Points
=
Contaminant Risks
44 Points

Contaminant risks*
= 44 pts

**** Truncate risk at 50 pts***

VERY HIGH

3. Level of Background Contamination

> MCL	21 - 50 pts
0.5 MCL to < MCL	11 - 20 pts
0.2 MCL to < 0.5 MCL	6 - 10 pts
'detect' to < 0.2 MCL	0 - 5 pts

Contaminant Risk Ratings

40 to 50 pts	very high
30 to < 40 pts	high
20 to < 30 pts	medium
< 20	low

Table 3. Risk Matrix for Contaminant Sources for Valley Motors – Volatile Organic Chemicals

Level of Risk Associated with the Highest Risk Sources

Next Highest Risk Sources(s)	Plastic and synthetic fiber manufacturer, 23.5 acres of residential area	**LOW 10 pts**	**MEDIUM 20 pts**	**HIGH 30 pts**	**VERY HIGH 40 pts**
Low		≥ 10 sources + 10 pts	≥ 10 sources + 5 pts	≥ 20 sources + 5 pts	---
Medium		---	≥ 2 sources + 5 pts	≥ 5 sources + 5 pts	≥ 10 sources + 5 pts
High		---	---	1 source + 10 pts	≥ 2 sources + 10 pts
Very High		---	---	---	1 source + 10 pts

Chart 8. Vulnerability analysis for Valley Motors – Volatile Organic Chemicals